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**BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES**

Application Number: 10/672,623
Filing Date: September 26, 2003
Appellant(s): TYSOE ET AL.

PATRICK S. YOKER
For Appellant

EXAMINER'S ANSWER

This is in response to the appeal brief filed March 5, 2007 appealing from the Office action mailed August 10, 2006.

(1) Real Party in Interest

A statement identifying by name the real party in interest is contained in the brief.

(2) Related Appeals and Interferences

The examiner is not aware of any related appeals, interferences, or judicial proceedings which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

(3) Status of Claims

The statement of the status of claims contained in the brief is correct.

(4) Status of Amendments After Final

The appellant's statement of the status of amendments after final rejection contained in the brief is correct.

(5) Summary of Claimed Subject Matter

The summary of claimed subject matter contained in the brief is deficient. 37 CFR 41.37(c)(1)(v) requires the summary of claimed subject matter to include: (1) a concise explanation of the subject matter defined in each of the independent claims involved in the appeal. The brief is deficient because the first four paragraphs of the Summary section are not material to the claimed subject matter, i.e. magnetic particles. The claimed invention is directed to soft magnetic particles only, not to

electromagnetic devices or methods of making such devices or methods of making magnetic particles as discussed in the first four paragraphs of the Summary.

(6) Grounds of Rejection to be Reviewed on Appeal

The appellant's statement of the grounds of rejection to be reviewed on appeal is correct.

(7) Claims Appendix

The copy of the appealed claims contained in the Appendix to the brief is correct.

(8) Evidence Relied Upon

The Moro patent: 6,940,388 MORO 09-2004

The RYU article: RYU et al., "Core loss depending on magnetizing angle from easy axis in grain-oriented 3% silicon-iron", June 2004.

(9) Grounds of Rejection

The following ground(s) of rejection are applicable to the appealed claims:

Claims 1-7 and 25-36 stand rejected under 35 U.S.C. 102(e) as being anticipated by the Moro patent (US 6,940,388).

Claims 1-7:

Claim 1: The '388 Moro patent teaches a dust core consists of a soft magnetic powder and an insulating binder (col. 2, lines 43-46). The insulating binder is present in an amount from, based on the magnetic powder, 0.3 wt-5 wt% and more preferably, 0.5 to 3.0 wt % (col. 5, lines 10-13). It is noted that the weight percent of resin as taught in the Moro patent is based on the magnetic powder, not on the entire dust core composition, whereas weight percent of resin as claimed is based on the total amount of the magnetic material, not just the magnetic first portion. Moro also teaches an amount of 1.2 wt% of the resin based on 100wt% of the magnetic particle, which is equivalent to 1.09 wt% of the resin based on the total dust core material. See Moro'388, col. 7, Table 1. An amount of 1.09 wt% meets the claimed language "about 1 wt%". Therefore, the Moro patent anticipates the claimed invention for disclosing an amount of 0.3 wt% to about 1 wt%.

Claim 2: The '388 Moro patent also discusses an amount of insulating binder less than 0.3wt% (col. 5, lines 13-15). "Disclosure of composition of matter in reference may be anticipatory even though reference indicates that composition is not preferred or even that it is unsatisfactory for intended purpose". In re Nehrenberg (CCPA), 129 USPQ 383.

Claim 3: See col. 2, lines 43-46.

Claims 4 and 5: See col. 3, lines 17-23.

Claim 6: See col. 3, lines 40-43.

Claim 7: See col. 3, lines 28-38.

Claims 25-30:

Claim 25: The '388 Moro patent teaches a dust core consists of a soft magnetic powder and an insulating binder (col. 2, lines 43-46). The '388 Moro patent also discusses an amount of insulating binder less than 0.3wt% (col. 5, lines 13-15) as undesirable because it increases core loss. "Disclosure of composition of matter in reference may be anticipatory even though reference indicates that composition is not preferred or even that it is unsatisfactory for intended purpose". In re Nehrenberg (CCPA), 129 USPQ 383. The low core loss of soft magnetic material with 3% of insulating silicone resin at a magnetic density of 1T and frequency 60 Hz has been determined to be lower than 2.5 W/kg, which is calculated to be equivalent to a core loss of below (2.5W/2.2lb=) 1.14 W/lb. See Ryu article, page 1821, figure 4. A core loss of 1.14 W/lb is almost 6 times lower than the core loss equivalent to the claimed soft magnetic material which is disclosed as 6 W/lb (see instant specification, page 2, paragraph [0008]). The Moro patent has predicted that any amount of silicone resin that is below 0.3 wt% (based on the weight percent of magnetic particles) would result in an increase of core loss. See Moro, col. 5, lines 10-17. A core loss of 6 W/lb (as reported in the instant specification at paragraph [0008]) is a significant increase from a core loss of below 1.14 W/lb possessed by the soft magnetic material taught by Moro. A core loss of 6 W/lb or lower when an amount of 1 wt% or below 0.15wt% of silicon resin is present in the soft magnetic material is not expected, but has been predicted by Moro. Therefore, a disclosure of insulating resin of less than 0.3wt% is an inherent disclosure of 0.05 wt%

to 0.15 wt% because the core loss of the resulting soft magnetic material is about the same.

Claim 26: See col. 2, lines 43-46.

Claims 27-28: See col. 3, lines 17-23.

Claim 29: See col. 3, lines 40-43.

Claim 30: See col. 3, lines 28-38.

Claims 31-36:

Claims 31-36 are directed to the same subject matter as claims 25-30, except that they do not include the limitation "elongated shape" of the magnetic portion. Therefore, claims 30-36 are anticipated by Moro for the same reasons applied to the rejection of claims 25-30 above.

(10) Response to Argument

A. Claims 1 and 25: The shape of the particle- Does elongated shape preclude flat?

Appellant argued that the "flat" particles as disclosed in the Moro patent do not teach the claimed elongated particles. Various standard dictionaries, including the American Heritage and the Merriam-Webster Dictionary, define "elongated" as "having more length than width". At col. 3, lines 41-43, Moro discloses a flat shape having an aspect ratio of 5 to 25, which ratio clearly defines an elongated shape. Appellant appears to think that 'elongated' means "not flat". "Elongated" only defines two dimensions, length and width, and does not relate to the third dimension (thickness). Therefore, whether a particle is flat or not, it can be elongated if one dimension is longer than the other.

Therefore, the Moro patent teaches the elongated particle as recited in claims 1, 25 and their dependent claims.

B. Claims 2, 25 and 31:The proportion of insulating binder in the magnetic material of 0.05 to 0.15 wt%.

Appellant argued that the Moro patent fails to teach an amount of 0.05 to 0.15 wt% of the insulating binder resin in the magnetic particle. The '388 Moro patent teaches a dust core consists of a soft magnetic powder and an insulating binder (col. 2, lines 43-46). The '388 Moro patent also discusses an amount of insulating binder less than 0.3wt% (col. 5, lines 13-15) as undesirable because it increases core loss. "Disclosure of composition of matter in reference may be anticipatory even though reference indicates that composition is not preferred or even that it is unsatisfactory for intended purpose". In re Nehrenberg (CCPA), 129 USPQ 383. A disclosure of an insulating resin of under 0.3 wt% is an inherent disclosure of all binder resin under 0.3 wt% including the claimed range of 0.04 wt% to 0.15 wt% for the following reasons. The low core loss of soft magnetic material with 3% of insulating silicone resin at a magnetic flux density of 1T and frequency 60 Hz has been determined to be lower than 2.5 W/kg, which is calculated to be equivalent to a core loss of below (2.5W/2.2lb=) 1.14 W/lb. See Ryu article, page 1821, figure 4. The magnetic material 3 wt% silicon-iron taught in the Ryu article is the same as the dust core disclosed in the Moro patent because Moro patent teaches an amount of silicone resin of 3 wt% as a preferred range in the iron dust core (See Moro, col. 5, lines 10-15). At page 2, paragraph [0008] of the instant

specification, Appellant reports that an insulating resin amount of 0.1 wt to 0.15 wt% in the claimed magnetic material would result in a core loss of 6 W/lb or less. A core loss of 1.14 W/lb (with 3 wt% resin) as taught in the Moro patent (and confirmed in the Ryu article) is almost 6 times lower than the core loss equivalent to the claimed soft magnetic material, which is disclosed as 6 W/lb (see instant specification, page 2, paragraph [0008]). The Moro patent has predicted that any amount of silicone resin that is below 0.3 wt% (based on the weight percent of magnetic particles) would result in an increase of core loss. See Moro, col. 5, lines 10-17. A core loss of 6 W/lb (as reported in the instant specification at paragraph [0008]) is a significant increase from a core loss of below 1.14 W/lb possessed by the soft magnetic material taught by Moro. A core loss of 6 W/lb or lower when an amount of 1 wt% or below 0.15wt% of silicon resin is present in the soft magnetic material is not new or unexpected, but has been predicted by Moro (as reported in the Ryu article). Therefore, a disclosure of insulating resin of less than 0.3wt% is an inherent disclosure of 0.05 wt% to 0.15 wt% because the core loss of the resulting magnetic material is about the same.

(11) Related Proceeding(s) Appendix

No decision rendered by a court or the Board is identified by the examiner in the Related Appeals and Interferences section of this examiner's answer.

For the above reasons, it is believed that the rejections should be sustained.

Respectfully submitted,

H. Thi Le

Conferees:

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CAROL CHANEY
SUPERVISORY PATENT EXAMINER

phys. stat. sol. (a) **201**, No. 8, 1819–1822 (2004) / **DOI** 10.1002/pssa.200304663

Core loss depending on magnetizing angle from easy axis in grain-oriented 3% silicon-iron

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The profiles of ac hysteresis loops have been measured as function of the angle ϕ between H-field and [001] axis in (110)[001] grain oriented 3% silicon-iron. As ϕ increases, for $\phi \geq 30°$ the loop changes into a wasp-waisted shape with inflection points. The observed ac hysteresis loop profiles have been analyzed in terms of domain reorientation under field. The core losses in silicon-iron are measured for various magnetizing angles with respect to the easy axis at magnetizing frequency 50 Hz and 60 Hz and at magnetic induction 1.3 T and 1.0 T. At magnetic induction 1.3 T, the core loss increased to near 70° and decreased at magnetizing frequency 60 Hz, but at 50 Hz this trend was different from 60 Hz and the core loss was monotonously increased.

1 Introduction The reorientations of magnetic domains during magnetization are associated basic magnetic properties, such as hysteresis loss, nucleation and annihilation field, Barkhausen noise, and magnetostriction [1–3]. The hysteresis loss increases monotonously with the angle between the H-field and [001] axis in grain oriented 3% silicon steel [1]. The nucleation and annihilation fields, and the magnetostriction in [001] axis under H-field are increased with angle [2, 3].

The domain structure in a ferromagnetic material under an alternating magnetic field varies in two ways: (i) the 180° domain spacing becomes closer as the magnetizing frequency is increased; and (ii) the walls may not remain planar at a sufficiently high magnetizing frequency, i.e. wall bowing occurs [4].

The domain dynamics for $\phi \geq 30°$ is more complicated by the appearance of zig-zag domains on the surface when the field increased, where ϕ is the angle between [001] direction and driving H-field. The zig-zag domains basically consist of domains magnetized along the ± [001] directions. Their boundaries lie at an angle of 55° from [001], corresponding to ⟨111⟩, and their folded boundaries are placed along the original 180° walls. It has been suggested that the zig-zag domain encloses the magnetic flux of the closure domains oriented in the ± [100] and/or ± [01] direction inside the specimen to reduce the magnetostatic energy. Therefore, 90° domain walls are formed at the boundaries between the closure and the zig-zag or original 180° domains. The folded boundaries are formed as a result of the decomposition of the 180° walls, however, there is no structural information available in the literature yet [1]. Although the core loss, magnetostriction, Barkhausen noise, and second harmonics on magnetizing field orientation in 3% silicon iron have been studied, the ac hysteresis loop has not yet been investigated [1, 3, 5].

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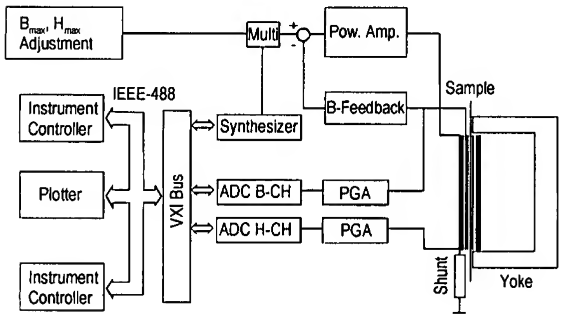


Fig. 1 Schematic diagram of the ac hysteresis loop and core loss measuring system for arbitrary wave form of the magnetic induction.

In the present work, the profiles of ac hysteresis loops and the core losses in grain oriented 3% silicon-iron are measured for various magnetizing angles with respect to the easy axis at magnetizing frequency 50 Hz and 60 Hz, and magnetic induction 1.3 T and 1.0 T.

2 Experimental The silicon-iron samples of dimensions 120 mm × 15 mm × 0.3 mm were prepared with the angle ϕ deviating from the [001] axis in (110)[001] grain oriented 3% silicon-iron. The schematic diagram of the core loss measuring system is shown in Fig. 1. A waveform synthesizer and *B*-feedback system are necessary for measuring the ac hysteresis loop and core loss under the desired waveform of the magnetic induction. For the generation of a desired magnetic induction waveform, we can calculate the secondary induced voltage waveform, and this waveform can be synthesized using the waveform synthesizer, and the secondary induced voltage can then be controlled to be the same as the synthesized voltage waveform using the *B*-feedback system. For the digitization of the secondary induced voltage and the voltage across the shunt resistor, which is connected to the primary winding serially to measure the magnetic field strength, a 12-bit two-channel transient recorder with a maximum sampling speed of 2×10^7 samplings/s and a memory size of four kwords per channel was used [6].

3 Results and discussion Figure 2 shows the change of the ac hysteresis loop for ϕ = 0°, 30°, 60° and 90° samples at magnetizing frequency 60 Hz and magnetic induction (a) 1.3 T and (b) 1.0 T. The ac hysteresis loop changes into a wasp-waisted shape above ϕ = 30°, and the hysteresis loops saturate from ϕ = 40° to 70° samples at 1.3 T, but 80° and 90° samples do not saturate (not shown in Fig. 2). Figures 3a and b show the change of the ac hysteresis loop for ϕ = 0°, 30°, 60° and 90° samples at magnetizing frequency 50 Hz and magnetic induction of 1.3 T and 1.0 T, respectively. The loop changes into a wasp-waisted type above ϕ = 30°, and all the loops do not saturate.

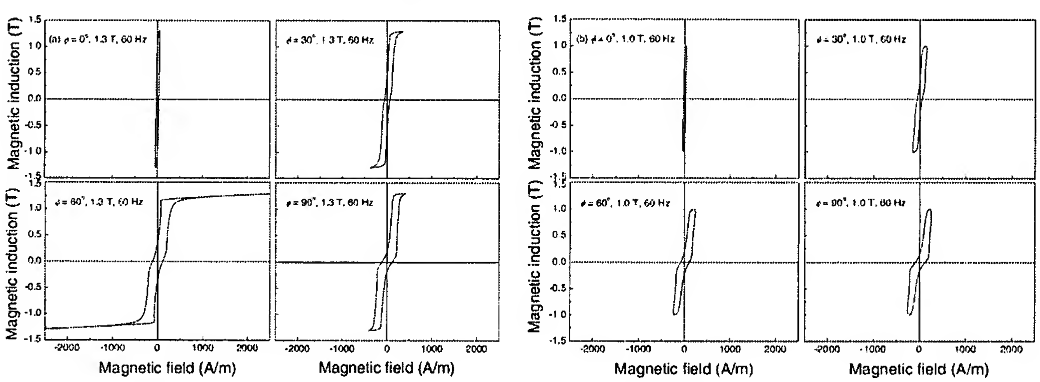


Fig. 2 Change of ac hysteresis loops measured at magnetizing frequency 60 Hz and magnetic induction (a) 1.3 T and (b) 1.0 T for ϕ = 0°, 30°, 60° and 90° samples. The loop changes into a wasp-waisted shape from ϕ = 30°.

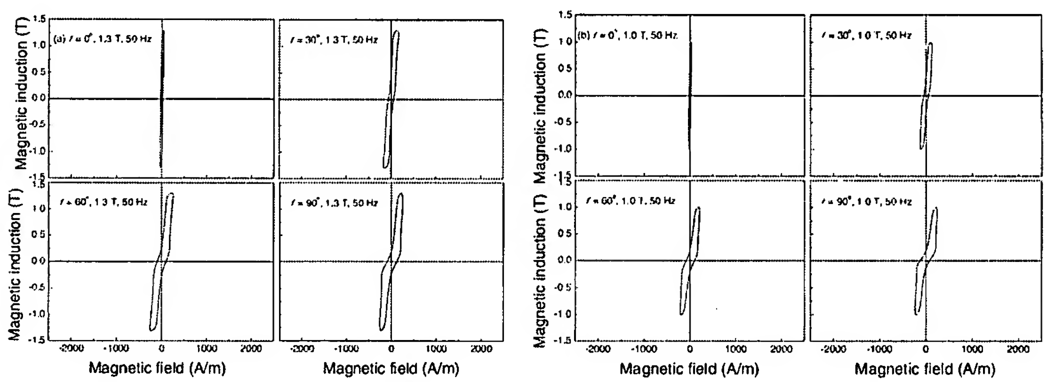
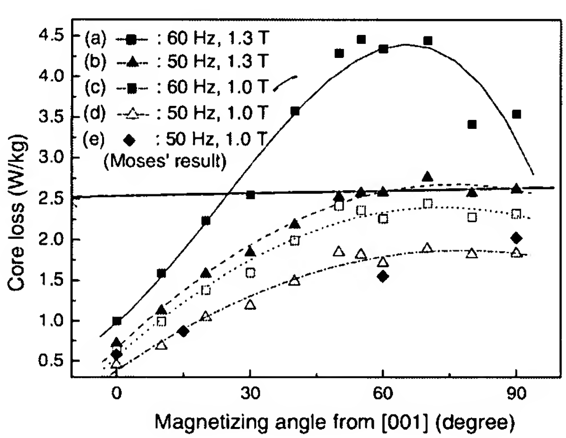


Fig. 3 Change of ac hysteresis loops measured at magnetizing frequency 50 Hz and magnetic induction (a) 1.3 T and (b) 1.0 T for $\phi = 0°$, 30°, 60° and 90° samples. The loop changes into a wasp-waisted shape from $\phi = 30°$.

Figure 4 shows the dependence of core loss on the magnetizing angle from the [001] crystallographic axis when the magnetic inductions are 1.3 T and 1.0 T, and magnetizing frequencies are 60 Hz and 50 Hz. As shown in Fig. 4, the core loss had a peak value near 70° at magnetic induction 1.3 T and magnetizing frequency 60 Hz, but the core loss increased monotonously depending on the magnetizing angle from the [001] direction at magnetic induction 1.3 T and magnetizing frequency 50 Hz. At magnetic induction of 1.0 T, depending on the magnetizing angle from [001] direction it shows similar trends for the magnetizing frequency 50 Hz and 60 Hz compared to magnetic induction 1.3 T. Especially, the trend of core loss at the magnetizing frequency 50 Hz and magnetic induction 1.0 T is in good agreement with Moses' result [5]. This sample has a critical angle which is difficult to be magnetized, this angle strongly depended on the magnetizing frequency and magnetic induction.

The ac hysteresis loss changes by the complex magnetic domains in grain oriented 3% silicon-iron as the zig-zag domains when the magnetizing angle increases from [001], pass into closure domains along ± [100] and ± [01]. The observed losses in alternating magnetization are due to micro eddy currents [7] and acoustic emission [8] associated with moving domain walls and magnetization rotation as the specimen undergoes magnetization, but we could not explain the core loss peak value at certain magnetizing angle. For more detailed explanation of this phenomenon, magnetic domain observations should be necessary.

The ac hysteresis loss increases with the number of irreversible events due to the interaction of domain walls with the material defects. The number of irreversible events during a magnetizing cycle is



4.5 W/kg = 4.5W / 2.20lb

2.04 W/lb

2.5 W/kg

1.15W/lb

1. 2.5/30 (2.2/1.1)

Fig. 4 Core loss depending on the magnetizing angle from [001] direction.

assumed to be proportional to the number and length of 180° and 90° domain walls and the number of defects encountered in the course of the $B-H$ loop. The nucleation and annihilation of zig-zag domains involving closure domain walls could account for the increase in the hysteresis loss with ϕ; in addition a contribution arises from the composition and decomposition of wall boundaries between 180° and folded zig-zag boundaries.

4 Conclusions The ac hysteresis loop and core loss depending on the magnetizing angle ϕ between [001] direction and H-field, have been measured at magnetizing frequencies of 60 Hz and 50 Hz, and magnetic induction 1.3 T and 1.0 T. The loops changed into a wasp-waisted shape $\phi \geq 30°$, because the domain dynamics for $\phi \geq 30°$ is more complicated by appearance of zig-zag domains. At magnetic induction 1.3 T, the core loss increased to near 70° and decreased at magnetizing frequency 60 Hz, but at 50 Hz this trend was different from 60 Hz and the core loss monotonously increased. At magnetic induction 1.0 T, the trends of core loss monotonously increased at 50 Hz and 60 Hz. These results are due to macroscopic phenomena, measurements of domain dynamics are necessary to know the mechanism of microscopic properties.

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